

### 3.3.3.6 One-Way and Two-Way ARQ

AMTOR ARQ mode sends in only one direction at a time and requires use of the OVER command to change the direction of data flow. AX.25 packet radio is flexible and either station may send data to the other station without use of an OVER command. CLOVER ARQ mode does not require an OVER command (like packet), but uses a precisely timed ARQ frame similar to that of AMTOR. When first linked, two CLOVER ARQ stations operate in "chat mode". Both stations may send a limited amount of data to the other (6 bytes per CCB). When the amount of buffered transmit data at one station exceeds 255 bytes, that modem shifts into data block mode, sending in the format shown for station "A" in Figure 3.6. Data from station "A" now flows at a high rate and in large blocks. However, data from station "B" will still be passed to "A" within the CLOVER Control Block (CCB). When station "A" has sent all of its buffered data, it reverts to the initial "CCB-level" of the protocol and both stations may continue in "chat mode". If station "B" now has bulk data to send, its modem shifts into data block mode and "A" remains in "chat mode".

This procedure is a very close match to the way that all current HF BBS stations operate. For example, to read a BBS message, your station makes short command transmissions (using "chat mode") and the BBS makes long transmissions (the requested message in block mode). Conversely, when you store a message in the BBS, your station uses block mode to send the message and the BBS responds with prompts and acknowledgements in "chat mode".

CLOVER-II also supports high rate block mode transmissions in *both* directions. In this case, when both station "A" and station "B" have large amounts of transmit data to send, both transmissions use block mode and data flow in the communications channel alternates direction each ARQ frame (approximately every 20 seconds). This is called the "Two-way ARQ mode" of CLOVER operation. Since transmitters and receivers switch ON and OFF alternatively, the mode is not truly "Full-Duplex" - data does not flow in both directions *simultaneously*.

Selection of "chat", "one-way", or "two-way" ARQ modes of operation is automatic and dynamic. The mode used is determined by the amount of buffered transmit data to be sent. The ARQ mode is always adjusted to make the most efficient use of the available time on the communications channel. CLOVER is therefore both bandwidth efficient *and* time efficient.

### 3.3.3.7 ARQ AUTOPOWER

CLOVER ARQ mode also includes the capability to dynamically adjust the power output of each transmitter. In most cases, the performance limit for data exchange is set by phase and frequency dispersion, and *not* by insufficient received signal power. When AUTOPOWER is ON, the CLOVER demodulator computes the "excess received S/N ratio" on each data frame, adds a safety margin, and the commands the transmitting station to adjust its power accordingly. Thus CLOVER uses only the minimum transmitter power required to carry-on communications. Often, the transmitter power output is 1 Watt or less. As in the case of adaptive modulation control, MY receiver sets HIS transmitter power. AUTOPOWER may be turned ON or OFF via PC-CLOVER command. AUTOPOWER is not used if either ARQ station has AUTOPOWER turned OFF. It is recommended that all automated stations turn AUTOPOWER ON and that user stations also set AUTOPOWER ON as much as possible. In some cases, the presence of strong ON/OFF local noise may require setting AUTOPOWER to OFF. CLOVER ARQ will adapt to this situation, but time may be gained by forcing both transmitters to full power (AUTO = OFF).

### 3.3.3.8 ARQ CQ Mode

The CLOVER CCB is also used to make a "general call for communications" - commonly known as "CQ". In this case, the originating station sends a "CQ CCB that includes his call sign. The receiving station's modem recognizes the CQ CCB, and decodes the call sign. *If the receiving station desires*, he may then press a key and initiate ARQ communications with the calling station. The listening station may also choose to ignore the CQ call by not taking any action.

### 3.3.3.9 ARQ Disconnect

Two types of disconnects are available in ARQ - "NORMAL" and "PANIC". A NORMAL disconnect request is processed in the order it is received. All data loaded into the modem prior to the disconnect is sent and acknowledged before the link is stopped. A PANIC disconnect will immediately cease transmitting at the originating station. The other station will then cease only when its retry counter is exceeded.

### 3.3.3.10 SEL-CAL & Scan-Control

The PCI-4000 includes a SEL-CAL switch output that may be used to control frequency scanning transmitters and receivers. As in the HAL PCI-3000, SEL-CAL output may be set for either continuous (low at connect, high at disconnect), or pulsed operation (pulse low at connect, pulse low at disconnect). The "NORMAL" (Ping) connect mode should be used to link with stations using frequency scanning equipment.

### 3.3.4 LISTEN Mode

PCI-4000 equipped stations may monitor ARQ or FEC transmissions of any CLOVER station. Listening stations are able to decode text and call signs of the sending stations.

Reed-Solomon error correction within a data block is provided in both FEC and ARQ listen modes. However, error correction via repeat transmission is only provided to the two linked ARQ stations and not to any stations that may be listening. When the error-correction capacity of the Reed-Solomon decoder is exceeded in Listen mode, all data for that block is lost.

The listening PCI-4000 station *must* correctly receive the CCB before any following data blocks may be decoded. If reception of a CCB is missed or corrupted, all data blocks between this and the next successfully received CCB will be lost. Since the period between CCB's is approximately 30 seconds in FEC mode and 20 seconds in ARQ mode, patience is required by the listening station operator, particularly when tuning a new signal.

### 3.3.5 CW ID

The PCI-4000 includes Morse code identification (CW ID) which may be set to OFF or for automatic operation in ten minute intervals. The MYCALL character stream may also be sent from the keyboard at any time. When used, CW ID always sends at a rate of 20 wpm (words-per-minute) using standard 1/3 dot/dash weight. CW ID is sent using tone #2 of the four tone set (2187.5 Hz).

### 3.4 CLOVER Bibliography

For those who desire additional information about CLOVER-II or CLOVER waveforms, the following articles may be of assistance.

Petit, Ray C.: "The CLOVER-II Communication Protocol - Technical Overview", ARRL 11th Computer Networking Conference Proceedings (1992), American Radio Relay League (ARRL), Newington, CT.

Henry, George W., Ray C. Petit: "HF Radio Data Communications: CW to CLOVER", Communications Quarterly, Spring, 1992, pp 11-24; CQ Publishing, Hicksville, NY.

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Petit, Ray C.: "CLOVER-II: A Technical Overview", ARRL 10th Computer Networking Conference Proceedings (1991), pp. 125-129; American Radio Relay League (ARRL), Newington, CT.

Petit, Ray C.: "CLOVER is Here", RTTY Journal, Fountain Valley, CA; January, 1991, pp. 16-18; February, 1991, pp. 12-13; March, 1991, pp. 16-17; April, 1991, p 10.